# Functional Safety Manual **RIA15**

Loop-powered 4 to 20 mA process indicator







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## 1 Manufacturer's declaration

SIL\_00514\_01.23 Endress+Hauser People for Process Automation Herstellererklärung - Manufacturer Declaration Funktionale Sicherheit - Functional Safety (IEC 61508:2010) Beiblatt 1 / NE130 Formblatt B1 - Supplement 1 / NE130 From B.1 Endress+Hauser Wetzer GmbH+Co. KG Obere Wank 1, 87484 Nesselwang erklärt als Hersteller, dass der folgende schleifengespeister Anzeiger für 4 ... 20 mA , oder 4 ... 20 mA mit HART® Kommunikation declares as manufacturer, that the following loop-powered process indicator for 4 to 20mA or 4 to 20mA with HART® communication RIA15-SIL in sicherheitsrelevanten Anwendungen SIL2 (HFT=0) nach IEC61508:2010 eingesetzt werden kann. is suitable for use in saftey relevant applications up to SIL2 (HFT=0) according to IEC 61508:2010. Für einen Einsatz in sicherheitsrelevanten Anwendungen entsprechend IEC 61508 sind die Angaben des Handbuchs zur Funktionalen Sicherheit zu beachten. In safety relevant applications according to IEC 61508, the instructions of the Safety Manual have to be followed. Nesselwang, 14.09.2023 Endress+Hauser Wetzer GmbH+Co. KG ppa. Harald Müller i.V. Robert Zeller **Director Technology** Head of Department R&D-Components 1/3

A0054143

## 1.1 Safety-related characteristic values

Allgemein Gerätebezeichnung Sicherheitsbezogen Fehlerstrom Bewertete Messgrö Sicherheitsfunktion	und zulässige Ausführungen	140			
Gerätebezeichnung Sicherheitsbezogen Fehlerstrom Bewertete Messgrö Sicherheitsfunktion	und zulässige Ausführungen			Sector Sector Sector Sector	
Gerätebezeichnung Sicherheitsbezogen Fehlerstrom Bewertete Messgrö Sicherheitsfunktion	und zulässige Ausführungen			A DESCRIPTION DE LA D	ATCACH!
Sicherheitsbezogen Fehlerstrom Bewertete Messgrö Sicherheitsfunktion		RIA15	6 (Bestellmerkmal "W	Veitere Zulassungen": Option	n LA "SIL")
Fehlerstrom Bewertete Messgrö Sicherheitsfunktion	e Ausgangssignale	420	ImA		
Sicherheitsfunktion	Ro / Euroktion	≤ 3,6	mA oder ≥ 21,0 mA		
	(en)	weiter	rleiten des Messsignals		
Gerätetyp gem. IEC	61508-2	🗹 Ту	pA	🗖 Тур В	
Betriebsart		Lo'	w Demand Mode	High Demand	Continuous Mod
Gültige Hardware-V	ersion	V01.0	0 oder höher		R
Sicherheitshandbuc	h	FY010	098K/09		
			Vollständige entwicklung	gsbegleitende HW/SW Bewe	ertung inkl.
<i>n</i>		-	FMEDA und Anderungsp Bewertung über Nachwe	rozess nach IEC 61508-2, 3 is der Betriebsbewährung H	; 1W/SW inkl. FMEDA
Art der Bewertung	(Shilber)		und Änderungsprozess n	ach IEC 61508-2, 3	15-86
(nor ente variante v	vanibar)		gem. IEC 61511	en nwr 5w zum Nachweis	Fruhere verwendun
6		Ø	Bewertung durch FMEDA	A gem. IEC 61508-2 für Ger	äte ohne Software
Bewertung durch /	Zertifikatsnummer	Intern	Internes Assessment		
Prüfungsunterlagen		Entwi	cklungsdokumente, Testrep	oorts, Datenblätter	-
SIL - Integrit	at	1	and the second se		
Systematische Siche	inersintegritat	Einka	naliger Einsatz (HFT = 0)	) SIL 2 fähig	SIL 3 fäh
Hardware Sicherhei	tsintegrität	Mehr	kanaliger Einsatz (HFT $\geq$ 1)	SIL 2 fähig	SIL 3 fäh
FMEDA			RIA15	- Comment in the second	and we have
Sicherheitsfunktion	(en)	-	weiterleiten des Messsign	als	
Apu <sup>1</sup> ,2)					1
λ <sub>5</sub> <sup>1),2)</sup>		-	21 FIT		· .
SFF - Safe Failure Fi	action		68%		
PFD <sub>avg</sub> für T1 = 1 Jal	nr <sup>2)</sup> (einkanalige Architektur)		4.4 · 10 <sup>-5</sup>		
PFD <sub>avg</sub> Tur 11 = 5 Jai	re -/ (einkanalige Architektur)		2.2 · 10 <sup>-8</sup> · 1/h		
PTC 3)			99 %		
Fehlerreaktionszeit	4)		n/a		
Diagnose-Testinter	rall <sup>5)</sup>		n/a		
MTTF 7)	91C **		n/a 414 years		
Frklärung		1	,ca.s		
Likiarung	Unser firmeninternes Qualitätere	202025	ont stallt dia Information	on zukünftig beberetur	ndan
	sicherheitsrelevanten systematis	chen Feh	alern sicher.	on zukunnug bekanntwerder	nuell
<ul> <li><sup>10</sup> FIT = Failure In Time</li> <li><sup>13</sup> Gülüg für gemittelte Bei einer durchschni</li> <li><sup>14</sup> PTC = Proof Test Cov</li> <li><sup>15</sup> Maximale Zeit zwisci</li> <li><sup>15</sup> In dieser Zeit werden</li> <li><sup>15</sup> Die Prozesssicherhei</li> <li><sup>17</sup> MTTF (Mean Time T</li> </ul>	, Anzahl der Ausfälle pro 10 <sup>9</sup> h Umgebungstemperaturen bis zu tilchen Dauereinsatztemperatur erage (Diagnoseaufdeckungsgrad en Fehlererkennung und Fehlerr alle online Diagnosefunktionen iszeit beträgt: Diagnose-Testinter o Failure) Dieser Wert berücksich	+40 °C (+ nahe +6 I von Ger reaktion mindeste vall x 10 tigt alle	+104 °F) 0 °C (+140 °F) sollte ein Fa rätefehlern bei manueller V ens Lx ausgeführt (32 min 10 (Berechnung nach IEC 6 Ausfallarten der Elektroni	ktor von 2,1 berücksichtigt Wiederholungsprüfung) inkl. Speichertest) 1508) kkomponenten gemäß Sier	t werden mens SN29500
					2

## 2 About this document

## 2.1 Document function

This supplementary Safety Manual applies in addition to the Operating Instructions, Technical Information and ATEX Safety Instructions. The supplementary device

documentation must be observed during installation, commissioning and operation. The requirements specific to the protection function are described in this safety manual.

General information on functional safety (SIL) is available at: www.endress.com/SIL

## 2.2 Symbols used

#### 2.2.1 Safety symbols

#### A DANGER

This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

#### **WARNING**

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

#### **A**CAUTION

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

#### NOTICE

This symbol contains information on procedures and other facts which do not result in personal injury.

#### 2.2.2 Symbols for certain types of information and graphics

#### 🚹 Tip

Indicates additional information

#### 

Reference to documentation

#### 

Reference to graphic

#### 

Notice or individual step to be observed

#### 1., 2., 3. Series of steps

L**→** Result of a step

**1, 2, 3, ...** Item numbers

**A, B, C, ...** Views

## 2.3 Supplementary device documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

The following document types are available in the download area of the Endress+Hauser website (www.endress.com/downloads):

#### 2.3.1 Further applicable documents

TI RIA15: TI01043K BA • RIA15: BA01073K, BA01170K • ORIA15: BA011570, BA012030 KA RIA15: KA01141K XA RIA15: XA01028R

#### 2.3.2 Technical Information (TI)

#### Planning aid

The document contains all the technical data on the device and provides an overview of the accessories and other products that can be ordered for the device.

#### 2.3.3 Brief Operating Instructions (KA)

#### Guide that takes you quickly to the 1st measured value

The Brief Operating Instructions contain all the essential information from incoming acceptance to initial commissioning.

#### 2.3.4 Operating Instructions (BA)

#### Your reference guide

These Operating Instructions contain all the information that is required in various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal.

## 2.3.5 Safety Instructions (XA)

Safety Instructions (XA) are supplied with the device, depending on the approval. They are an integral part of the Operating Instructions.

Information on the Safety Instructions (XA) that are relevant for the device is provided on the nameplate.

## 3 Design

Н

## 3.1 Permitted devices types

The details pertaining to functional safety in this manual relate to the device versions listed below and are valid as of the specified firmware version.

Unless otherwise specified, all subsequent versions can also be used for safety functions.

A modification process according to IEC 61508 is applied for any device modifications.

Any exemptions from possible combinations of features are saved in the Endress +Hauser ordering system.

Valid device versions for safety-related use:

#### 3.1.1 Ordering features

RIA15-

Feature: 010 "Approval" Version: all

Feature: 020 "Housing" Version: all

Feature: 030 "Input" Version: all

Feature: 550 "Calibration" Version: all

Feature: 570 "Service" Version: all

Feature: 580 "Test, certificate" Version: all

Feature: 590 "Additional approval"

Version: LA Version "LA" must be selected for use as a safety function as per IEC 61508. All other versions are permitted in addition to "LA".

Feature: 610 "Accessory mounted" Version: all

Feature: 620 "Accessory enclosed" Version: all

Feature: 895 "Marking" Version: all

## 3.2 Identification marking

SIL-certified devices are marked with the SIL logo 💷 on the nameplate.

## 3.3 Safety function

The device's safety function is: Transmit the measuring signal without distortion

#### 3.3.1 Safety-related measuring signal

The safety-related measuring signal is the 4 to 20 mA signal (NE 43), which is transmitted without distortion.

The display function (current signal/HART<sup>®</sup> communication) of the device is **not** part of the safety function.

#### NOTICE

In an alarm condition

• Ensure that the equipment under control achieves or maintains a safe state.

## 3.4 Basic conditions for use in safety-related applications

The measuring system must be used correctly for the specific application, taking into account the installation and ambient conditions. Carefully follow instructions pertaining to critical process situations and installation conditions from the Operating Instructions. The

application-specific limits must be observed. The specifications in the Operating Instructions and the Technical Information must not be exceeded.

#### 3.4.1 Safety-related failures according to IEC/EN 61508

#### No device error

- No failure
- No effect on the safety-related measuring signal

#### λS (Safe)

- Safe failure
- No effect on the safety-related measuring signal:

#### $\lambda_{DD}$ (Dangerous detected)

- Dangerous failure which can be detected
- Affects the safety-related measuring signal: low alarm or high alarm

#### $\lambda_{DU}$ (Dangerous undetected)

- Dangerous failure which cannot be detected
- Affects the safety-related measuring signal: can distort the measuring signal

#### 3.4.2 Restrictions for safety-related use

- The 0 to 20 mA transmission range must not be used in safety-related applications.
- Take the voltage drop at the RIA15 into account when supplying the current loop. See BA, TI, KA.
- If there is no low voltage detection in the current loop, a voltage drop of at least 3 V at the RIA15 without backlight function must be taken into account when designing the current loop.

## 3.5 Dangerous undetected failures in this scenario

An incorrect measuring signal that deviates from the value specified in this manual, but is still in the range of 4 to 20 mA, is considered a "dangerous, undetected failure".

## 3.6 Useful lifetime of electrical components

The established failure rates of electrical components apply within the useful lifetime as per IEC 61508-2:2010 section 7.4.9.5 note 3.

In accordance with DIN EN 61508-2:2011 section 7.4.9.5, national footnote N3, appropriate measures taken by the manufacturer and operator can extend the useful lifetime.

This device does not contain any electronic components as per the "EMCRH Electrical & Mechanical Component Reliability Handbook" Third Edition (exida.com) that have a useful lifetime less than 50 years.

However, the useful lifetime can be significantly shorter if the device is operated at higher temperatures.

## 4 Commissioning (installation and configuration)

## 4.1 Requirements for personnel

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- Trained, qualified specialists must have a relevant qualification for this specific function and task.
- ▶ Personnel must be authorized by the plant owner/operator.
- Be familiar with federal/national regulations.
- Before starting work: personnel must read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- Personnel must follow instructions and comply with general policies.

The operating personnel must fulfill the following requirements:

- Personnel are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- Personnel follow the instructions in this manual.

## 4.2 Installation

The mounting and wiring of the device and the permitted orientations are described in the Operating Instructions pertaining to the device.

Correct installation is a prerequisite for safe operation of the device.

## 4.3 Commissioning

The commissioning of the device is described in the Operating Instructions pertaining to the device.

Before operating the device in a safety instrumented system, perform a verification using a test sequence  $\rightarrow \cong 12$ .

## 4.4 Operation

The operation of the device is described in the Operating Instructions pertaining to the device.

## 4.5 Device configuration for safety-related applications

## 4.5.1 Configuration of the measured value display

Refer to the Operating Instructions for information on configuration. The settings do not have a modifying effect and do not affect the current signal. The additional voltage drop in the current loop must be taken into account when switching to HART<sup>®</sup> communication.

## 4.5.2 Device protection

The device must be protected (to lock operation).

## 5 Operation

## 5.1 Device behavior when switched on

The measured value is displayed when current flows in the range of 4 to 20 mA.

## 5.2 Safe states

Safe state/measuring signal:

- Measured value not distorted
- $I \le 3.6 \text{ mA}$  (Low alarm)
- $I \ge 21 \text{ mA}$  (High alarm)

## 6 Proof testing

#### NOTICE

► The functional integrity of the device must be verified during commissioning, in the event of changes and at appropriate intervals. The time intervals must be specified by the operator.

#### **A**CAUTION

#### The safety function is not guaranteed during a proof test

Suitable measures must be taken to guarantee process safety during the test.

- ► The safety-related output signal 4 to 20 mA must not be used for the safety instrumented system during testing.
- A completed test must be documented; the template provided in the Appendix can be used for this purpose. (See Section 8.2)
- ► The operator specifies the test interval and this must be taken into account when determining the probability of failure PFD<sub>avg</sub> of the sensor system.

If no operator-specific proof-testing requirements have been defined, the following is a possible alternative for testing the device. The individual proof test coverages (PTC) that can be used for calculation are specified for the test sequences described below.

#### NOTICE

► If there is a fault in the current loop before testing starts, the cause of the fault must be first eliminated.

#### Proof testing and optimization of subsystems

The NAMUR worksheet NA106 "Flexible proof testing of field devices in safety instrumented systems" describes how the test activities can be optimized for PCS protective systems with regard to interruptions in operation while maintaining the required safety integrity of the installed PCS safety instrumented systems.

Proof testing of the device can be performed as follows: Test sequence: Verification of the measurement accuracy in the range of 4 to 20 mA

Note the following for the test sequences:

- The device must be checked in the closed current loop with the measuring devices installed.
- The accuracy of the measuring device used must meet the required accuracy of the application.

## 6.1 Test sequence

#### Preparation

1. Device identification:

Check device tag, device name, serial number and hardware version

2. Visual inspection:

- Wiring
- Housing/housing cover
- Mechanical and electrical installation

#### Proof-test procedure

1. Simulation of a high alarm ( $\geq$  21 mA) in the current loop.

2. Check the accuracy of the measuring signal in the current loop using appropriate measuring equipment, e.g. read out the measured value at the safety control.

3. A deviation in the measuring signal from the expected accuracy means that the device has failed the proof test.

This test detects 99 % of dangerous, undetected failures (proof test coverage, PTC = 0.99).

## 6.2 Verification criterion

If the test criteria from the test sequence described above is not satisfied, the device may no longer be used as part of a safety instrumented system.

- The purpose of proof-testing is to detect dangerous undetected device failures ( $\lambda_{DU}$ ).
- The impact of systematic failures on the safety function is not covered by this test and must be assessed separately.
- Systematic faults can be caused by operating conditions and the installation, for example.

## 7 Repair and error handling

## 7.1 Maintenance

Alternative monitoring measures must be taken to ensure process safety during configuration, proof testing and maintenance work on the device.

## 7.2 Repair

Repair means restoring functional integrity by replacing defective components.

#### Only original Endress+Hauser spare parts may be used for this purpose.

Document the repair with the following information:

- Serial number of the device
- Date of the repair
- Type of repair
- Person who performed the repair

Components may be repaired/replaced by the customer's technical staff if **original Endress+Hauser spare parts** are used (they can be ordered by the end user), and if the relevant installation instructions are followed.



Installation Instructions are supplied with the original spare part and can also be accessed in the Download Area at www.endress.com

Send in replaced components to Endress+Hauser for fault analysis.

When returning the defective component, always enclose the "Declaration of Hazardous Material and Decontamination" with the note "Used as SIL device in a safety instrumented system.

Information on returns: http://www.endress.com/support/return-material

## 7.3 Modification

Modifications are changes to SIL devices that are already delivered or installed:

- Modifications to SIL devices by the user are not permitted because they can impair the functional safety of the device
- Modifications to SIL devices may be performed onsite at the user's plant following approval by the Endress+Hauser manufacturing center
- Modifications to SIL devices must be performed by personnel authorized to do so by Endress+Hauser
- Only original spare parts from Endress+Hauser may be used for modifications
- All modifications must be documented in the Endress+Hauser Device Viewer (www.endress.com/deviceviewer)
- All modifications require a change nameplate or replacement of the original nameplate.

## 7.4 Decommissioning

When decommissioning, the requirements according to IEC 61508-1:2010 section 7.17 must be observed.

## 7.5 Disposal

## X

If required by the Directive 2012/19/EU on waste electrical and electronic equipment (WEEE), the product is marked with the depicted symbol in order to minimize the disposal of WEEE as unsorted municipal waste. Do not dispose of products bearing this marking as unsorted municipal waste. Instead, return them to the manufacturer for disposal under the applicable conditions.

## 8 Appendix

## 8.1 Structure of the measuring system

The RIA15 loop-powered indicator is used to display a measuring signal proportional to the current signal of a 4 to 20 mA current loop or alternatively to display a measured value scanned via HART<sup>®</sup> communication.

The display function (current signal/HART  $^{\mbox{\tiny (B)}}$  communication) of the device is not part of the safety function.

The safety-related measuring signal is the 4 to 20 mA signal (NE 43), which is transmitted without distortion.



## 8.2 Commissioning or proof test report

## 8.2.1 Test report – Page 1

Company/contact person	/
Tester	

Device information			
Facility	Measuring point/TAG no.:		
Device type/Order code			
Serial number	Hardware version		

Verification information
Date/time
Performed by

Verification result				
Overall result	Passed	□ Failed		

Comment:			

Date

Signature of customer

Signature Tester

## 8.2.2 Test report – Page 2

#### Type of safety function

□ Safe measurement

#### Proof testing

 $\Box$  Test sequence



This report is based on the specifications in the Functional Safety Manual: FY01098K

Proof test report					
Test step	Target value	Actual value	Passed		
1. Simulation of a high alarm ( $\geq$ 21 mA) in the current loop			□ Passed □ Failed		
2. High alarm, accuracy complies with technical data			□ Passed □ Failed		

#### Comment:

## 8.3 Version history

Version of manual	Changes	Valid as of firmware version	Reference to NE 53 customer information
FY01098K/09/EN/01.23	First version	01.05.01	FY01098K/09/EN/ 01.23



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